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INFORMATION OVERLOAD AND THE OPERATIONAL COMMANDER

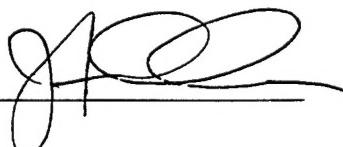
by

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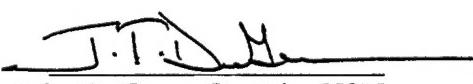
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The Contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

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Abstract of

INFORMATION OVERLOAD AND THE OPERATIONAL COMMANDER

Joint Vision 2010 envisions a future where improved information technology will enable operational commanders to accomplish a greater number of operational tasks more quickly. The inherent problem with processing larger volumes of data, faster, is the increased likelihood of the operational commander suffering from various degrees of information overload. Decision making paralysis occurs after an individual becomes information saturated. This phenomena is not unique to the military, and many clues for better information management can be found in the business world on Wall Street. A system for measuring information overload was developed by reviewing the environment in a command center, establishing the similarities between operational commanders and mutual fund managers, and analyzing fund manager information management techniques. Recommendations for reducing information overload in support of achieving the goals of Joint Vision 2010 were also derived.

Background

Our army must become more commandable in battle. We must create a new battle plan with a better arrangement of our chieftains and Huns. We must use tactics that control our maneuvers.

Wess Roberts, *Leadership Secrets of Attila the Hun*¹

The U.S. Armed Forces are using Joint Vision 2010 as an overarching guide “in developing their unique capabilities within a joint framework of doctrine and programs as they prepare to meet an uncertain and challenging future.”² One of the certain facts about the future is that we will be living in an age dominated by the growing power of information. “The vision of future warfighting embodies the improved intelligence and command and control available in the information-age.”³

The Joint Vision 2010 (JV2010) premise that the environment is going to be information based implies that mastering information is going to be vital to achieving future success. JV2010 predicts information technology will “improve the ability to see, prioritize, assign, and assess information... and will allow a greater number of operational tasks to be accomplished faster.”⁴ The conceptual framework for the military achieving that capability is imbedded in synchronizing Intelligence, Information Superiority, and Network Centric Warfare.^a

Applying both Moore’s and Metcalfe’s laws^b, the current technological expansion will continue. The decreasing cost of increasingly sophisticated information processing tools will also make those tool more widely availability. Over the next 10 years and beyond, operational commanders will have to be much more adept at processing greater volumes of information arriving at greater rates. That information will have to be efficiently organized and displayed to optimize operational commanders’ ability understand that data and use it to make sound

^a Intelligence is: 1) The product resulting from the collection, processing, integration, analysis, evaluation, and interpretation of available information concerning foreign countries or areas, and 2) Information and knowledge about an adversary obtained through observation, investigation, analysis, or understanding. (Joint Pub 2-0. p. GL-8)

Information Superiority is the capability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary’s ability to do the same. (Joint Pub 3-13. p. GL-7)

Network Centric Warfare is an information superiority-enabled concept of operations that generates increased combat power by networking sensors, decision makers, and shooters to achieve shared awareness, increased speed of command, higher tempo of operations, greater lethality, increased survivability, and a degree of self-synchronization. In essence, it translates information superiority into combat power by effectively linking knowledgeable entities into the battle space. (Alberts, 2.)

^b Moore’s Law: The performance of computer chips doubles every 18 months. Metcalfe’s Law: The cost of deploying a network increases linearly with the number of nodes in the network, the potential value of a network increases as a function of the square of the number of nodes connected by the network.

decisions. Additionally, information will have to be processed in a radically compressed time frame to achieve and maintain full spectrum dominance.

Confronted by the increasing requirements to achieve success in the information age, how will Operational Commanders prevent information overload while processing the operational intelligence required for achieving the goals of Network Centric Warfare? The key to preventing the decision making paralysis caused by information overload may be found by examining the “information war” being waged in the business world on Wall Street today.

Insights from Traders and War Games

The battles fought by operational commanders and those fought in the financial markets both exist in hectic, data saturated environments. The New York Stock Exchange traders’ comments, after participating in a command center exercise during the Marine Corps Warfighting Lab’s *Traders War Game Series*, provide valuable insights into factors that contributed to the operational commanders’ sense of information overload.^c The traders noted that the digital presentation of the battle information was too complex and yet, incomplete, and that the displays were only visible to and only understandable by the technical operators. The traders also observed a lack of synchronization between the visual and audio information. They did not understand how the commander could base his decisions on displays he could not read, especially when the voices over the radios seemed to sum up the critical issues in a way the computer screens did not.⁵ Of note, the traders were not negatively impacted by the volume or speed at which information arrived. The same could not be said of the general officers conducting mock trading on the stock market. The traders concluded that, like traders, succeeding in a command center environment required special skills and aptitudes and that some testing mechanism should be implemented for selecting candidates who exhibited those abilities.⁶

^c Applying the theory that commodity traders fight digital economic war every day, the USMC Combat Development Command sought their assistance. Starting in 1995, traders on the New York Mercantile Exchange volunteered their expertise to assist in developing techniques for decision-making on the digital battlefield. Traders, assisted by Marines, manned command centers, and Marine General officers, assisted by traders, went to the exchange to trade. The program was called the Trader War Game Series.

Additional insight into the impact data display and organization has on information overload in the command center is provided in the GLOBAL 99 Executive Summary.^d When discussing “converting information into actionable knowledge,” the draft asserts that information is only going to be useful for directing the battle if the operational commander plays a significant role in determining the information needed.⁷ It also notes, “Users should also have the capability to tailor the software and presentation tools to meet their unique requirements. The warfighter must be able to find the information that is relevant to the situation and consistent with his or her warfighting paradigm, and not be distracted by information that cannot be assimilated.”⁸ Finally, the draft reports that, “Schemes are needed for prioritizing and displaying information to enhance the speed of understanding, and subsequent action by the war-fighter.”⁹

Mechanics and Impacts of Information Overload

Factors that slow a commanders’ ability to comprehend and act on information can be attributed to information overload. Information overload hampers, and in its most sever cases, paralyzes, a leader’s most critical function – decision making. The need for future operational commanders to process more information, faster, has an inherent drawback - the physical capacity of the short-term working memory of the human brain. Tests have shown that people are only capable of processing about seven bits of information at a time. While long-term memory seems to have an infinite capacity, not all information gets processed through the short-term memory buffer into long-term memory. Therefore, the ability to process new, and bring to bear already stored information is severely limited. The human brain can only absorb information so fast. “As a result, we cope with the mass of information that constitutes reality by in effect, ignoring most of it.”¹⁰

Given the physical limitations of human mental processes, information overload occurs when individuals feel they are being presented too much information, the information arrives too quickly, or a combination of the two. The stress generated by the inability to resolve the increased information volume versus the reduced time to process it has the net effect of

^d Background summary: GLOBAL 99 was held in McCarty Little Hall at the Naval War College, Newport RI from 13 to 22 September 1999. The game was executed with tools that will be characteristic of Information Age Warfare, enabled the players to experience the co-evolution of that technology with new operational concepts, and provided some necessary concrete texture to the implications of information superiority and Network Centric Warfare at the operational level of war.

degrading comprehension. In response to this dilemma, humans tend to focus on recognizable bits of data, resulting in tunnel vision "... which causes people with relevant information to fail to see its relevance, make unwarranted inferences, and or fail to connect different parts of the information available to form coherent interpretations."¹¹

A future outcome of the negative effects of information overload on an organization dependent on executing the concepts of Network Centric Warfare could be orders of magnitude worse than a non-network centric organization. Information paralysis and the cascading failure and isolation of a network's critical nodes could cause a loss of the synergy and power normally drawn from shared awareness.

Mutual Fund Managers -- The Operational Commanders of Wall Street

Why compare successful mutual fund managers to operational commanders? Mutual fund managers exist in a highly competitive and unrelenting information-age environment where their daily survival or failure is determined by the marginal differences in actionable information held by the participants. Successful fund managers have the vision to execute fund strategies^e better than their peers. The successful managers are more efficient at extracting, filtering, processing, and analyzing discrete, yet key market indicators from the tremendous depth and volume comprising the "information noise" associated with the mostly level playing field of available market information. These managers achieve higher rates of success over time because they have developed the greatest sensitivity and agility to react to those indicators. Most importantly, successful managers excel in the daily information battles by overcoming the greatest obstacle all, succumbing to the potentially paralyzing effects of information overload.

Mutual fund managers and operational commanders are each charged with similar responsibilities, extracting the best possible intelligence and acting upon that information, in a timely manner, to ensure a wide range of smaller goals are met to achieve their overall objective. Success for both depends on clearly defining goals and crafting and executing supporting plans

^e Ellis, 172-174. Examples include Aggressive Growth Funds (looking for maximum capital gains from stock that are expected to appreciate faster than the market), Asset Allocation Funds (spreads assets among a variety of investments such as U.S. and foreign stocks, bonds, precious metals etc. altering the mix to enhance returns), Income Funds (managed to generate steady income rather than capital gains), Index Funds (portfolio closely duplicates an index such as Standard & Poor's 500-stock index to mirror index performance) and Money-market Fund (invests in short-term government securities, bank certificates of deposit and other low-risk, low return securities).

to achieve those goals. The more accomplished managers establish concepts that provide focus and unity of effort to their staffs, clearly define what constitutes success, and most importantly, identify the business equivalent of the “centers of gravity”^f¹²

What is a Successful Mutual Fund Manager?

Fund managers work in an organization whose sole business is to pool investors' money and invest in stocks, bonds, and money-market instruments. Mutual funds are evaluated by professional investment management staffs that track the markets, monitor the fund's investments, and decide when and what to buy and sell. On average each fund holds between 70 to 90 issues. Mutual funds provide a wide spectrum of investment strategies that also offer varying degrees of risk.¹³

The mutual fund finder on Morningstar.com provides comparative data for more than 6,500 mutual funds.¹⁴ Selecting managers with proven track records is useful for identifying individuals who have been successful at managing the problem of information overload. The parameters selected from the available categories in Quicken.com's Mutual Fund Finder were a rating of five stars, Morningstar's highest, a five-year average return of 35 percent or greater, which beat the overall average of less than 13 percent, and mutual fund managers who managed their funds for more than five years, to ensure the success of the fund could be attributed to the manager and not an anomalous positive spike in returns.¹⁵ Only five of the 6,500 funds were selected by that particular search.^g

^f Assumption: Providing operational focus was determined though analysis that determined the best perceived course(s) of action (COA) to achieve the objective. Joint doctrine defines centers of gravity (COG) as those characteristics, capabilities, or localities from which a military force derives its freedom of action, physical strength, or will to fight. In the context of this paper, a financial manager's COG is the key for making sound decisions and integrates intelligence and operations – the ability to gather good information and act upon it in a timely manner is the power for the mutual fund manager. The process of determining the COG requires the organization, and ultimately the fund manager to determine and carefully evaluate critical market factors (strengths and weaknesses).

^g Based on Morningstar database updated October 1999. Managers were Kevin Landis (FirstHand Technology Value), David Alger (Alger Capital Appreciation Retirement), Bruce Behrens & Leeham Burke (Flag Investors Communications A), Bill Miller (Legg Mason Value Prime), and Jim Oelschlager (White Oak Growth Stock). Doug MacKay co-manages a fund with Jim Oelschlager.

How Successful Fund Managers Cope with Information Overload

It's not what we don't know that causes trouble. It's what we know that ain't so.

Will Rogers¹⁶

Academic Perspective

Dr. J. Edward Russo, Associate Professor of Marketing and Behavioral Science at Cornell University's Johnson Graduate School of Management and Dr. J. H. Schoemaker, Associate Professor of Decision Sciences and Policy in the Graduate School of Business at the University of Chicago offer insights on preventing the paralysis that can be caused by information overload. Their studies determined the bulk of managers spent most of their time gathering intelligence and coming to conclusions, rather than analyzing the problem – a term they refer to as framing. To improve information control, Russo and Schoemaker recommend that managers use a formatted or systematic approach to problem solving and that they delegate information gathering. They contend that the wise decision-makers receive the highest quality intelligence only after clearly assessing what information is needed to make a decision and then using that assessment to shape and focus the intelligence gathering activities of their subordinates – a point that will assist operational commanders.

Additionally, the professors determined that the more successful managers avoid a fondness for evidence that confirms, rather than challenges, their current beliefs. Ultimately, the most successful managers have a good understanding of what they know and what they don't know. That understanding, supported by a good staff, and the managers' personal experience and intuition, gives them the ability to make a decision even if some data are missing – thus avoiding information paralysis.

Dr. Ralph Stacy, Strategic Management Professor at the Business School of the University of Hertfordshire in Hertford, observed that successful managers think in terms of an overarching vision and then identify a particular process to realize that vision. By studying complex, dynamic systems, managers understand that the behavior of a system cannot be understood simply by examining the system's parts. Thinking, therefore, has to proceed in terms of whole systems, its interconnections, and the patterns of behavior it may generate. It is especially helpful to try to find the most sensitive points in a system – the points of greatest leverage. By operating at these points, rather than trying to control details everywhere, managers

can bring about the greatest changes in the system with the least effort.¹⁷ This concept is analogous to an operational commander focusing his efforts on the center of gravity.

Stacy also states that the best managers have strong pattern recognition abilities and a good sense of history. Upon seeing a change, they automatically know an appropriate response based on their experience. They look at patterns of development, recognize the general, qualitative patterns that evolve from the information noise and use them to establish a range of choices that they should consider; not only for analysis, but for providing quality descriptions of patterns of behavior. Creative managers use analogies based on qualitative similarities to previous experience when they develop new mental models to design actions for each new strategic situation they confront.¹⁸ The best managers have superior market situational awareness, and the ability to quickly react to even subtle changes.

Consultant Perspective

The leaders in the financial services industry are actively searching for quicker methods to process larger volumes of information to gain a competitive edge. Information visualization, where information is displayed in recognizable graphic elements, is moving into mainstream applications as a remedy for information overload.¹⁹ In "The Big Picture," an article published in *Computerworld* (August 1996), Teresa Yrastorza noted that information visualization "allows users to spot patterns or relationships within streams of data in situations that more conventional methods of ordering (data rows, columns, spreadsheets) cannot, due to the amount and complexity of the information."²⁰ Gary Gomez of Booz Allen & Hamilton Incorporated noted that visualization allows users to view an entire system and track the effect each bit of datum has on all of the other data.²¹

"In finance," according to Yrastorza, "highly analytical trading-related systems have already become crucial in managing the proprietary trading of the major finance industry players and an important service offered to their valued clients. As a result, visualization-based technology is expected to proliferate on Wall Street."²² Using this theory to support the operational commander, the Defense Advanced Research Projects Agency's (DARPA's) command post of the future initiatives include showing the common operational picture in three dimensions.²³ "Information visualization doesn't make decisions, but it really focuses efforts," concludes Gomez.²⁴

Responding to the question of what the successful mutual fund managers use to manage the tremendous volume of available market information, *Morningstar* analyst Scott Cooley wrote, “A lot of them use quantitative tools” like graphs and spreadsheets “in an effort to filter out the market “noise”” and isolate trends or their own predetermined indicators. He further wrote, “Managers then do in-depth, fundamental research.”²⁵ When asked how managers cope with the additional information generated during a market crisis, Cooley wrote, “Some managers have automatic responses to certain events. For example, managers, in what's called the momentum camp, frequently sell a stock immediately after a company issues an earnings warning, posts a profit that was below expectations, and so on. These managers don't even try to get to the bottom of the issue; they just sell immediately.”²⁶ In effect, they ignore most of the market data, responding only to a discrete set of filtered data.

Addressing the issue of information overload, *SmartMoney*'s Lewis Braham indicated that mutual fund managers have not escaped entirely from the specter of information overload either. All managers must spend time reviewing the open sources like *Bloomberg* and individual company reports for basic information, but to get the insightful intelligence that keeps them ahead of the their peers in the market, Braham wrote, “For more in-depth information, managers often have their own team of analysts doing research. Quantitative fund managers will also develop their own proprietary computer models for analyzing all the data they receive. That is how they separate good information from the bad.”²⁷

But, according to Braham, the real secret to a fund managers' success is having a keen sense of history, and being savvy enough not to get trapped by that history. The successful managers will stick to their own philosophical strategy only as long as it actually works. “There is an ‘in the trenches’ quality to managers like Bill Miller of Legg Mason,” says Braham, “He not only is looking backward at what investment strategies worked in the past, but he has his finger on the pulse of today and is willing to adapt with the times.”²⁸

There is a famous saying by a Greek philosopher Heraclitus: “You cannot step into the same river twice.” In other words, what worked yesterday may not work today. Braham argues, “Speed and adaptability are essential, especially in markets as volatile and rapidly moving as today's. Information is disseminated so quickly over the Web today that a stock can lose half of its value in the span of an hour. The manager that cannot adapt to a new paradigm will be left behind. At the same time, the manager who isn't aware of history may not realize solutions to problems already exist.”²⁹

Fund Manager Perspective

Based on the analysis of the academics and financial consultants, there are two main processes fund managers use for analyzing data, the technology driven quantitative (black box) and the experience (art of the market) driven qualitative analysis. Neither is mutually exclusive, as managers have to blend the two types of analysis to best support their particular fund management styles. Answering the question about when “enough information is enough” to make a decision before succumbing to information overload, a *qualitative* Doug MacKay, Co-Manager, Red Oak Tech Select Fund, wrote, “We like to say that three things drive the stock market, interest rates, earnings, and the stuff you don't know. Fortunately, of the stuff you don't know, 90 percent of it you are probably better off not knowing in the first place, as it likely won't matter in the longer term.” MacKay went on to write, “I would say being as calm as possible, through the upturns and downturns, helps in the market, as well as the realization that you're probably not as smart as others think you are on the upside, nor as stupid as they think you are on the downside. When things get rough in the market, sometimes you're better off going for a walk in the park.” From the operational commander's perspective, this implied stepping back, reviewing the situation, and putting things back in perspective. “Keeping things simple also helps. Trading a ton in a down market is akin to rearranging deck chairs on the Titanic, probably not too productive.”³⁰

In a subsequent discussion on methods of reducing the effects of information overload, MacKay related that his company didn't like to rely too heavily on “black boxes” to crunch the numbers, preferring instead to keep focus on their two key factors: interest rates and earnings – factors for which they have developed good mental barometers that confirm or refute their suspicions about impending changes in the market.³¹ This qualitative philosophy is akin to an operational commander maintaining the sharp fidelity of his situational awareness so he can sense changes by simply monitoring for pattern shifts based on a few key indicators.

When asked about what unique displays his firm uses, MacKay indicated they have developed their own proprietary research homepage that employs company links based on keyword searches to more efficiently organize and display the information in their own database – an Executive Information Portal (EIP)^h “A successful EIP requires effective technology, but it

^h EIPs have the ability to gather, filter, and sort data more efficiently than human operators. EIPs can show unread e-mail messages, unresolved tasks, and various key indicators – such as real time financial information for different regions or customers. It can also alert the fact that certain important are outdated.

is more about understanding business processes and how workers use resources. People need to be able to access information without having to stumble through layers of ‘info smog’” says Alden Globe, program manager for the Knowledge-and-Information-Systems Group at J.D. Edwards.³² The inability to organize data was also a finding from GLOBAL 99.

Since MacKay and his analysts don’t have to think much about the process of gathering relevant data, they spend their efforts and experience on interpreting the information in the context of their overall strategy. “Access to more info is not always better,” said MacKay, “because at some point, (market) art and experience will carry the day.”³³

Examining a manager who focuses more on utilizing *quantitative* market analysis, *SmartMoney*’s Lauren Young’s “On Top of the World” article asked the key question about the secrets to Alger Funds manager David Alger’s long-term success. Alger’s personal mantra is “know everything.” His group maintains exceptional market situational awareness by systematically reviewing as much data as possible. Alger analysts are expected to speak not only to management, but also to suppliers, customers, anyone who might know anything about the company. After scrutinizing his analysts’ information, Alger is quick to tweak the investment formula if the magic potion isn’t working.³⁴ In order to take full advantage of today’s technology, Alger recently hired IBM to create artificial-intelligence models called “Deep Green” that use more than 20 pieces of technical information to analyze stocks for all his accounts. In trial runs, Deep Green spotted problems in companies that later, did in fact stumble. Deep Green, says Alger, “is going to put a turbocharger on our stock-picking process.”³⁵ In support of an operational commander, better “black boxes” could facilitate analyzing the vast amounts of data that are not evaluated, leading to the discovery of previously unrecognized enemy patterns of behavior.

The current batch of 17 Alger analysts, who cover a total of 1,400 stocks, are charged with finding companies with investment strategies that meet his investment philosophy. They are, however, susceptible to getting lost in the details of their research. One outcome is analysts “can get too hung up on some of these stocks by trying to be right,” says Alger, and sometimes “they are too intent on sticking with a company long after the data shows it’s time to sell.”³⁶ Alger has to guard against his analysts’ tunnel vision and resulting loss of objectivity, which degrades the quality of the intelligence estimates he receives. A telling final thought, “Despite his elaborate computer models, meetings with analysts, and Deep Green, Alger admits that finally, it’ll come down to intuition.”³⁷

Examining how successful fund managers developed a deeper understanding of the company fundamentals without getting lost in the search for relevant data, *Fortune Magazine's* Jodi Mardesich examined Kevin Landis' success in managing Firsthand Funds by writing, "How did Landis, a former engineer who hadn't managed money ... put up such spectacular numbers? The answer is simple: firsthand knowledge."³⁸ Phil Mosakowski of Firsthand Finance confirmed their company "looks for individuals who were experts with technical experience... people who have the knowledge base to understand company fundamentals."³⁹ Simply stated, they seek established technical experts, and train them.

Applying Mutual Fund Managers Secrets

We have two choices. We can advance by developing radically new theories to help us understand what we now see in the data. Or, we can go back, denying what is now readily apparent to most, bending the data through even more convoluted econometric process, until it screams its compliance with our preconceptions.

- Robert A. Haugen, *The New Finance The Case Against Efficient Markets*⁴⁰

Discussing how mutual fund managers' information management techniques could be applied to military operational commanders, Professor Jeffery Heisler from the Boston University's School of Management, theorized that a system would have to organize and present information to individuals based on their preferences and needs. Keeping the concept of human factors in mind, he also indicated that the presentation would have to be succinct, summarize important issues, and have a provision for organizing and filtering data to ensure information that didn't meet a certain threshold or requirement stayed below the presentation horizon.⁴¹

Every officer who has worked for a new superior understands that the information provided up and down the chain of command is shaped by the preferences of the commander. One method for decreasing information overload for both operational commanders and their staffs would be achieving a higher degree of display standardization. Yet, until some degree of standardization can be established, it will be difficult to meet Professor Heisler's conceptual framework for information management because the vast array of unique commander preferences and the complex spectrum of potential presentation schemes and tools makes it too complex to generate a homogenous solution for preventing information overload for an operational commander.

The Model

However, what can be done, having already described the cognitive dynamics that lead to information overload, drawing from the insights gained from the *Traders Games Series* and GLOBAL 99, and the analysis of the fund managers' range of information overload managing methods, is apply Stacy's notion of seeking the points of greatest leverage to capture the general elements that either induce or prevent information overload. Using both qualitative and quantitative means, it was possible to derive variables to describe, in general terms, the various aspects that make up information overload. As a result, it may be possible to monitor for and prevent conditions that lead to the worst type of information overload, information paralysis. The three major components that explain the information overload variables are described as:

- 1) Information Processing (P): P has two major sub-components that capture actions applied to data, quantitative (qn) and qualitative (ql) analysis. Assuming a finite set of all data, the operational commander and his staff only work on the subset of data that they are seeking or that is already known to them.
- 2) Information Display (D): D has two major sub-components, organization (o) and presentation (pr). Operational commanders need to have information organized in line with their way of thinking. Once they get the information where and when they need it, it has to be presented in a manner that can be most easily absorbed and comprehended. An example of optimizing D would be tailoring networked information on a portal, and using visualization or virtual reality technology to present that information.
- 3) Human Characteristics (H): H has two major sub-components, knowledge (k) and performance (pf). Knowledge captures the essence of the individual's expertise, experience, and situational awareness. Performance captures the individual's ability to perform under the pressures created by both time and information. An individual may be highly knowledgeable, but may fail to perform under pressure. Conversely, a brave or heroic individual may accomplish tremendous deeds without knowledge. Optimizing H would have an individual who can both perform and have knowledge.

How the Model Works

Qualitatively, each variable in the set represents a factor that either contributes to or reduces the level of information overload. Quantitatively, the relationship between (P, D, H) is described by using a three-dimensional rectangular coordinate system, with each variable representing a different axis. Thus, information overload (IOL) is expressed as: (Don't worry the math is easy)

$$IOL = (P(qn, ql), D(o, pr), H(k, pf))$$

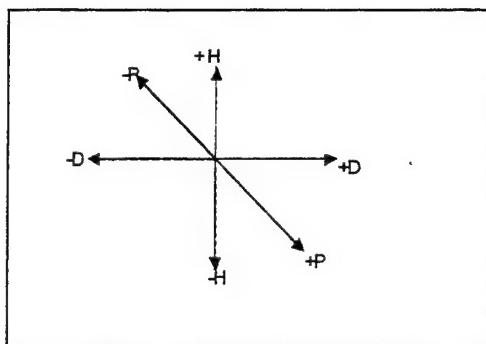


Figure 1. Information Overload Coordinate System

This convention allows the different states of information overload to be verbally and graphically represented such that each variable's influence on causing or reducing information overload is measurable.ⁱ If all variables are positive (P, D, H), the plot will fall in the first octant,⁴² representing the optimal conditions for an operational commanders' decision climate. By deduction, any variable combination not in the optimal octant expresses a particular state of information overload, where paralysis occurs when all variables are negative. Thus, a quantitative description of paralysis is described by the set:

$$IOL = (-P, -D, -H)$$

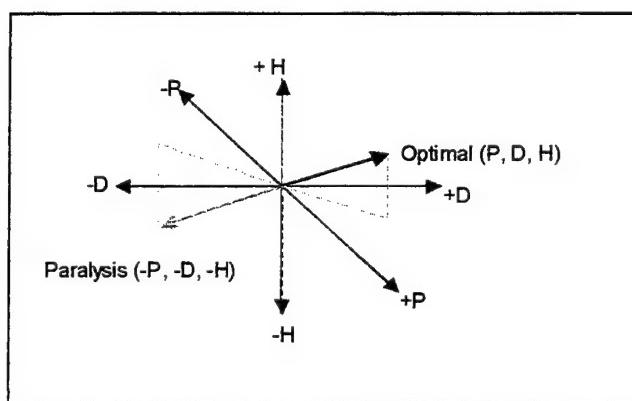


Figure 2. States of Information Overload

ⁱ Until the calculus or regression analysis can be conducted, the measurement may not be accurately described using the mathematical, ratio scale of measurement, however, a description of measurement will fall into one of the remaining measurement scales: interval, ordinal, or nominal.

The qualitative description could state the data was not analyzed or processed, it was not organized or able to be reviewed, and the individual did not have the expertise, situational awareness, or ability to react to it. This methodology is important because it describes, in detail, why the operational commander experienced information overload, which is the first step to resolving the problem. Plotting IOL positions over time could help the operational commander head off conditions that draw him towards paralysis, allowing him to actively seek shorter paths to an optimal decision climate.

Defining the metrics for IOL variables, the calculus for applying them, and proving the validity of this concept will require further research. However, as a final example, a simplified snapshot from GLOBAL 99 could be explained by the set (P, -D, -H). Explaining this conclusion, the game scenario accounted for all P, D could not be tailored or prioritized, and for H, the players were initially unfamiliar with the scenario and operating the tools for information age warfare.

Finally, the IOL graph system clearly indicates the strong probability that operational commanders will experience varying degrees of information overload, confirming another lesson from the mutual fund managers, the fog caused by information overload cannot be totally avoided. This, however, does not have to be taken as a negative comment. Certain levels of stress, even those caused by information overload, tend to improve efficiency when kept to manageable levels. The IOL model illustrates that only one in eight octants causes severe degradations to decision making. The successful mutual fund managers, competing in a much more evenly matched environment, have proven that is possible to thrive in an information saturated environment.

Conclusion

The information age envision in JV2010 will continue to expand our ability to gather information at speeds and volumes that exceed human capabilities, increasing the potential for information overload to paralyze the operational commanders' decision making. Today's operational commanders can benefit from the successful mutual fund managers' lessons learned by striving to develop better methods for perceiving important changes in the dynamic information based environment. To accomplish this goal, the commanders must continue

focusing and training their staffs using the improving quantitative and qualitative methods of analyzing, organizing, and displaying information, and by increasing everyone's understanding of the fundamentals of Network Centric Warfare. In doing so, the U.S. Armed forces will be more able to synchronize and thus standardize information management practices.

Most radically, in order to apply the lessons learned from successful fund managers' ability to survival, the U.S. Armed Forces will have to depart from the practice of employing generalists. Not only are successful mutual fund managers highly trained, seasoned, and savvy experts, they are the individuals with the specialized cognitive abilities that allowed them to thrive while running the gauntlet of market natural selection. If operational commanders are going to excel in the information age, they too will have to survive a selection process to assure they have the knowledge and special skills to manage Network Centric Operations. This may require a fundamental organizational change, where officers are placed in a specialized command track. After the services identify their command specialists, it will be imperative that they use education to focus specialists' abilities, training to hone their skills, and exercises to maintain their proficiency at the levels necessary to meet and exceed the expectations and goals of Joint Vision 2010.

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